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ABSTRACT

A study was conducted to determine if attentional difficulties would be found in reading disabled children and to discover if increasing the complexity of a task would result in a relative decrease in the performance of the children. Twelve dyslexic boys, aged eight and nine, and 12 normal subjects similar in age and IQ participated in the study. The subjects were tested for reaction time and then completed a computer controlled test (Discriminant Reaction Time--DRAT), which combines reaction time and number discrimination and requires the subject to observe rapidly presented digits and to respond by pressing a button each time a designated number appears. If the subject responds before the next digit appears, the rate of presentation is speeded. If he or she misses the number or responds late, the rate is slowed. Performance is defined in terms of the average rate of stimulus presentation for the missed stimuli with a correction made for false hits. Results showed that the dyslexic children were significantly slower on reaction time when compared to the control group children and performed significantly worse than the controls on the DRAT. The poor performance on the DRAT supports the theory that reading disabled children are less able to focus on relevant task items for a sustained period. (FL)

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DISCRIMINANT REACTION TIME AS A MEASURE OF ATTENTION IN THE READING DISABLED CHILD

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IT IS GENERALLY ACCEPTED THAT THERE ARE MULTIPLE ETIOLOGIES OF READING UNDERACHIEVEMENT, INCLUDING SOCIOPSYCHOLOGICAL (DEFICIENCIES IN COGNITIVE STIMULATION, CULTURAL DEPRIVATION, POOR MOTIVATION OR INEFFECTIVE TEACHING TECHNIQUES), PSYCHOPHYSIOLOGICAL (GENERAL MEDICAL PROBLEMS, SENSORY OR INTELLECTUAL DEFECTS OR BRAIN INJURY), AND GENETIC (HEREDITARY TRANSMISSION) (SALTZ AND VAN NOSTRAND, 1973).

WITHIN THIS HETEROGRENOUS ETIOLOGICAL FRAMEWORK, A SUBGROUP OF CHILDREN EXIST WHO ARE RETARDED IN READING DESPITE CONVENTIONAL INSTRUCTION, A STIMULATING ENVIRONMENT, INTACT SENSES, AVERAGE INTELLIGENCE AND THE ABSENCE OF GROSS MEDICAL, NEUROLOGICAL AND PSYCHIATRIC PROBLEMS. THIS READING PROBLEM IS REFERRED TO AS SPECIFIC DEVELOPMENTAL DYSLEXIA.

ROURKE (1975), POINTED OUT THAT A FEATURE OF MANY CHILDREN WITH LEARNING DISABILITIES IS "THEIR EXTREME DIFFICULTY IN MAINTAINING ATTENTION", DYKMAN ET AL. (1971), CONCLUDED THAT THERE IS CONSIDERABLE EVIDENCE TO SUPPORT THE VIEW THAT ATTENTION DEFICITS ARE CENTRAL TO LEARNING DISABILITIES.

PAST LITERATURE HAS ESTABLISHED GENERALITIES IN READING DISABILITY BUT WITH LITTLE SPECIFICATION OR AGREEMENT ON THE TYPE OF ATTENTION INVESTIGATED. FURTHER, THERE HAS BEEN A TENDENCY FOR RESEARCHERS TO UTILIZE HETEROGENOUS GROUPS OF LEARNING DISABLED CHILDREN.

THE PRESENT EXPERIMENT UTILIZED SIMPLE REACTION TIME WHICH HAS BEEN USED AS A MEASURE OF ATTENTION IN A NUMBER OF STUDIES INVOLVING HETEROGENOUS

GROUPS OF LEARNING DISABLED CHILDREN AND A TEST COMBINING REACTION TIME AND NUMBER DISCRIMINATION CALLED DISCRIMINANT REACTION TIME (DRAT). THESE WERE USED TO HELP DETERMINE IF ATTENTIONAL DIFFICULTIES ARE FOUND IN A WELL DEFINED POPULATION OF READING DISABLED CHILDREN AND TO SEE IF INCREASING THE COMPLEXITY OF THE TASK RESULTS IN A RELATIVE DECREMENT IN THE PERFORMANCE OF THE READING DISABLED CHILD.

THE DRAT IS A COMPUTER CONTROLLED TEST OF SUSTAINED ATTENTION OVER A FIFTY-SECOND PERIOD IN WHICH THE SUBJECT OBSERVES RAPIDLY PRESENTED SINGLE DIGITS AND RESPONDS BY PRESSING A BUTTON EACH TIME THE NUMBER FOUR APPEARS. IF HIS RESPONSE OCCURS BEFORE THE NEXT DIGIT APPEARS, THE RATE OF PRESENTATION IS SPEEDED BY SIX PERCENT. IF HE MISSES A FOUR OR RESPONDS LATE, THE RATE IS SLOWED BY SIX PERCENT. THE SUBJECT'S THRESHOLD OF PERFORMANCE IS DEFINED AS THAT POINT WHERE HE IS LIKELY TO MISS AT ONE RATE AND JUST HIT AT THE SIX PERCENT SLOWER RATE. PERFORMANCE IS DEFINED IN TERMS OF THE AVERAGE RATE OF STIMULUS PRESENTATION FOR THE MISSED STIMULI WITH A CORRECTION MADE FOR FALSE HITS. EACH CHILD WAS ADMINISTERED THREE FIFTY-SECOND TRIALS OF THE DRAT WITH THE BEST SCORE OF THESE TRIALS USED IN THE DATA ANALYSIS. THE TEST OF SIMPLE REACTION TIME EMPLOYS A FIXED FORE PERIOD OF THREE SECONDS. IN THAT TIME, THE SUBJECT DEPRESSES A LEVER ON CUE FROM THE COMPUTER AND IS TOLD TO LIFT HIS FINGER AS QUICKLY AS POSSIBLE WHEN A SMALL RED LIGHT IS FLASHED IN FRONT OF HIM. THE PROCEDURE CONSISTS OF FIFTEEN TRIALS AND THE AVERAGE OF THE BEST EIGHT TRIALS WAS USED AS THE SCORE ON THE TEST. THIS TOO REQUIRES A PERIOD OF SUSTAINED ATTENTION TO A SPECIFIC STIMULUS.

SUBJECTS

TWELVE RIGHT-HANDED CAUCASIAN BOYS AGED 8 - 9 WERE RECRUITED FROM METROPOLITAN DETROIT DISABILITY PROGRAMS AND SCHOOLS. THESE BOYS WERE SELECTED TO CONFORM AS CLOSELY AS POSSIBLE TO THE WORLD FEDERATION OF NEUROLOGY DEFINITION OF SPECIFIC DEVELOPMENTAL DYSLEXIA (WAITES, 1968). THE OPERATIONAL DEFINITION OF READING RETARDATION FOR THIS STUDY REQUIRED THAT EACH CHILD OBTAINED A PEABODY PICTURE VOCABULARY TEST (PPVT) (DUNN, 1965) INTELLIGENCE QUOTIENT OF AT LEAST 90, A PEABODY INDIVIDUAL ACHIEVEMENT TEST (PIAT) (DUNN AND MARKWARDT, 1970) WORD RECOGNITION STANDARD SCORE OF AT LEAST TEN POINTS BELOW THE PPVT AND BE BEHIND SAME AGED PEERS IN READING RECOGNITION AS MEASURED BY THE PIAT.

A GROUP OF CONTROL SUBJECTS RECRUITED FROM THE SAME LOCAL AREA WERE MATCHED TO THE READING DISABLED SUBJECTS ON PPVT IQ, SOCIOECONOMIC STATUS (MINIMUM FAMILY INCOME OF $12,000 PER YEAR), AGE, RACE AND HANDEDNESS.

DEMOGRAPHIC DATA FOR THE SUBJECTS CAN BE SEEN IN TABLE 1, AS WELL AS PROBABILITY LEVELS FROM T-TESTS. THE GROUPS DID NOT DIFFER BY AGE OR IQ BUT DIFFERED SIGNIFICANTLY ON READING RECOGNITION LEVEL. ALL CHILDREN AND AT LEAST ONE PARENT WERE INTERVIEWED BY THE FIRST AUTHOR TO SCREEN OUT THOSE WITH ANY HISTORY OF MEDICAL, NEUROLOGICAL OR EMOTIONAL PROBLEMS THAT MIGHT HAVE INTERFERRED WITH THE ACQUISITION OF READING SKILLS.

In addition, each parent was administered the Personality Inventory for Children as a device to screen out children with significant pathology.

The PPVT was chosen for intellectual matching since it measures receptive language which provides an estimate of basic intelligence independent of reading ability (Dunn, 1965).

A completely randomized analysis of variance was carried out on the reaction time and DRAT data. The reading disabled children were found to be significantly slower on reaction time when compared to the control children and performed significantly worse on the DRAT ($p<.005$).

Discussion

The DRAT couples discrimination of numbers with reaction time and demands on increase in information processing within a sustained attention task when compared to simple reaction time. As the demands of the task increased, the performance gap between the reading disabled and control children increased. This supports the theory that reading disabled children are less able than normal children to focus on relevant task items for a sustained period. An alternative explanation suggests that the children may differ in the amount of time necessary to process information.

A longer cortical information processing time would result in slower

REACTION TIME PERFORMANCE AND SINCE THAT DRAT IMPOSES A HIGHER INFORMATION PROCESSING LOAD, IT SHOULD TAKE RELATIVELY EVEN LONGER.

A POSSIBLE MECHANISM THAT COULD ACCOUNT FOR THE INCREASED PROCESSING TIME WOULD BE DELAYED MYELINATION OF THE ASSOCIATION AREAS OF THE BRAIN AND THE CORRESPONDING SLOWING OF CONDUCTION SPEED.

REMEDIATION TECHNIQUES THEN MIGHT BENEFIT FROM ALLOWING THE READING DISABLED CHILD LONGER TIME TO MAKE LETTER DISCRIMINATIONS. SELF PACING MIGHT ALSO PROVE HELPFUL IN THAT THE CHILD CAN PROCESS THE MATERIAL AT HIS OWN "SPEED".

THESE RESULTS SHOULD BE INTERPRETED WITH CAUTION SINCE DIFFERENCES FOUND BETWEEN YOUNGER CHILDREN ARE FREQUENTLY NOT PRESENT IN STUDIES OF ADOLESCENTS. ALSO, READING DISABILITY HAS MULTIPLE ETIOLOGIES. ATTTENTIONAL OR PROCESSING DIFFICULTIES MAY APPLY TO ONLY SOME CHILDREN OR MAY BE A COMPONENT IN A MATRIX OF DEFICIENCIES.

MEASURES OF ATTENTION

	REACTION TIME AVERAGE		DRAT	
	MEAN	SD	MEAN	SD
CONTROL	272.8	30.0	495.6	44.0
READING DISABLED	301.3	30.6	561.8	58.1
P<	.031		.005	

TABLE I

DEMOGRAPHIC VARIABLES

	AGE IN MONTHS		PPVT IQ		READING PIAT RECOGNITION SS	
	MEAN	SD	MEAN	SD	MEAN	SD
CONTROL	111.58	5.64	113.16	12.71	111.67	8.29
READING DISABLED	107.33	7.14	107.33	8.39	83.00	9.13
P <		.1200		.1980		.0001